Management of Localized Prostate Cancer and an Incidental Ureteral Duplication With Upper Pole Ectopic Ureter Inserting into the Prostatic Urethra

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Ectopic ureters are rare congenital malformations of the renal system that most commonly present in females. It is extremely rare to encounter an ectopic ureter in an older man undergoing radical prostatectomy. We report herein a case of a 66-year-old man with prostate cancer and a complete duplication of the left renal collecting system, with an upper pole ectopic ureter and associated normal functioning renal parenchyma entering into the prostatic urethra. This anomaly was incidentally discovered on preoperative magnetic resonance imaging of the prostate. Open radical retropubic prostatectomy and a left ureteroureterostomy were performed.
[Rev Urol. *2008;10(4):297-303*]

Key words: Prostate cancer • Ectopic ureter • Prostatic urethra • Prostatectomy • Ureteroureterostomy

Ectopic ureters are rare and occur in about 1 of 1900 live births.[1] Over 85% of ectopic ureters are associated with duplicated systems and most commonly present in females. Ectopic ureters present 2 to 12 times less frequently in males than in females, and in males are most commonly associated with a single collecting system.[2] Ectopic ureters inserting into the prostatic urethra often present with obstruction and/or urinary tract infections. Few cases of ectopic ureters entering into the prostatic urethra as an incidental finding in men undergoing radical prostatectomy for prostate cancer have been reported in the literature.[3,4] This case report describes a patient with prostate cancer and an asymptomatic upper

pole ectopic ureter inserting into the prostatic urethra associated with normal functioning renal parenchyma demonstrated on preoperative mercaptoacetyltriglycine (MAG-3) renogram, magnetic resonance imaging (MRI), and computed tomography (CT). We discuss the treatment plan for this patient and give an overview of ectopic ureters.

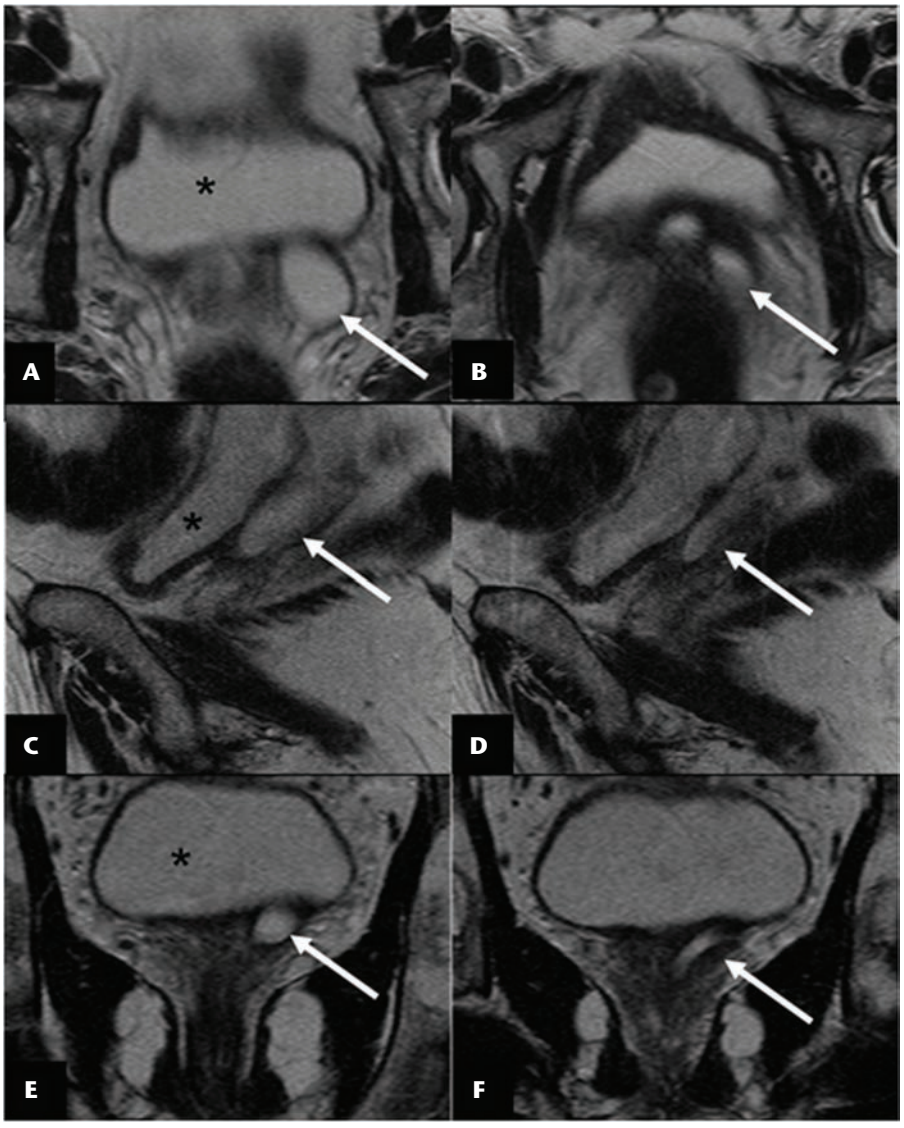
Case Presentation

A 66-year-old man presented with a nodule at the right base of the prostate on digital rectal examination. The patient's serum prostate-specific antigen level had risen from 0.92 ng/mL in September 2004 to 2.2 ng/mL in December 2007. A transrectal ultrasound (TRUS)–guided biopsy demonstrated adenocarcinoma of the prostate with Gleason score 6 (3 + 3) disease found in 30% of 1 core obtained from the right lateral base (clinical stage T2a disease). The patient reported nocturia 2 times per night without other lower urinary tract symptoms, and no history of urinary tract infections or nephrolithiasis. The patient's American Urological Association Symptom Score was 3. He had no complaints of abdominal pain, pelvic pain, discomfort with ejaculation, or infertility (the patient has 2 children).

The past medical history was remarkable for significant coronary artery disease, diabetes mellitus, hyperlipidemia, hypertension, paroxysomal atrial fibrillation, and scoliosis. The patient was on multiple medications for hypertension, diabetes mellitus, and high cholesterol. There was no family history of prostate or breast cancer. The patient had a 50 pack-year smoking history, which he discontinued in 2003. On physical examination, there was no costovertebral angle tenderness bilaterally and the abdomen was soft, nontender, and nondistended, with normal bowel sounds. The testes were bilaterally descended without masses. Both epididymides and vasa were unremarkable. There were no inguinal hernias. There was a 1-cm nodule occupying the right lateral portion of the prostate base that was confined to the gland.

A preoperative MRI of the prostate before and after intravenous gadolinium contrast injection including dynamic imaging of the inguinal areas during Valsalva was performed to stage the prostate cancer prior to radical prostatectomy and to identify occult inguinal hernias. On MRI, the prostate was small, with a calculated volume of 14 cc. There were nonspecific low T2 signal areas throughout the peripheral zone without focal mass and no evidence of gross extracapsular extension, seminal vesicle invasion, or pelvic lymphadenopathy. A left dilated ectopic ureter inserting into the prostatic urethra was incidentally noted (Figure 1).

Figure 1. *Axial* (A, B), *sagittal* (C, D), *and coronal* (E, F) *T2-weighted images show ectopic insertion of a dilated left ureter inserting into the prostatic urethra. *Urinary bladder.*



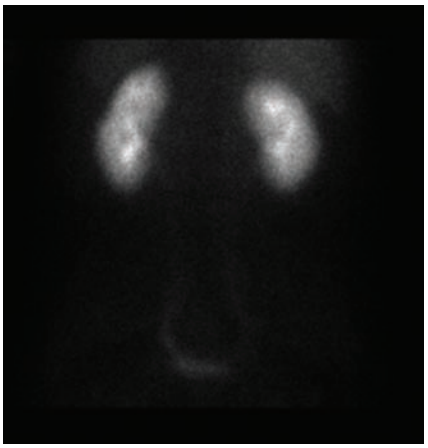


Figure 2. *Renogram with injection of mercaptoacetyltriglycine (MAG-3) without lasix of the kidneys. The time to peak was 4 minutes bilaterally. The clearance half-time was 17.9 minutes on the left and 14.9 minutes on the right. The split function was 40.6% for the left and 59.4% for the right.*

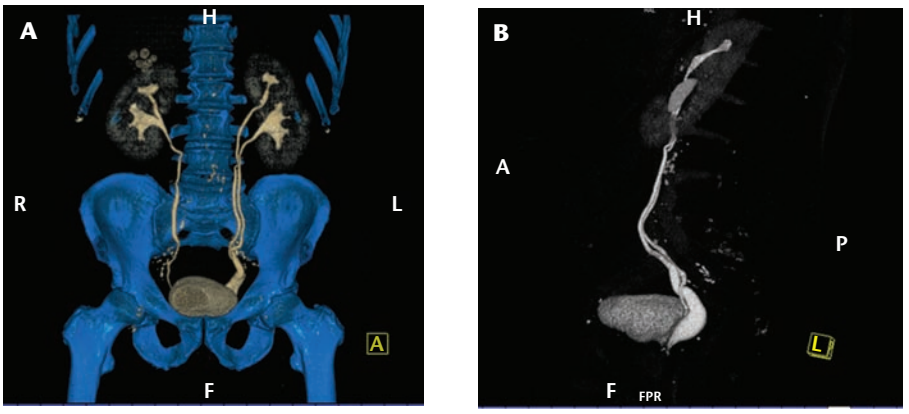


Figure 3. *Three-dimensional volume rendered* (A) *and maximum intensity projection images obtained from the computed tomography urogram. The images showed partial duplication of the right pelviocalyceal system with a single right ureter and complete duplication of the left pelviocalyceal system with 2 left ureters* (A). *The lower pole left ureter is of normal course and caliber and enters the bladder orthotopically. There is fusiform dilatation of the distal portion of the upper pole left ureter as it terminates in the prostatic urethra* (B).

A MAG-3 renogram (Figure 2) demonstrated normal right renal function. On the left, there was prompt uptake and excretion of the isotope in both the upper and lower pole moieties.

A CT urogram with reformats was obtained to better visualize the anatomy of the left duplicated system and associated upper pole ectopic ureter (Figure 3). CT showed a partial duplication of the right pelviocalyceal system with a single ureter emptying directly into the bladder. There was complete duplication of the left collecting system and ureter. The lower pole ureter was not dilated and drained orthotopically into the bladder. The upper pole ureter was dilated distally and terminated in the prostatic urethra. Otherwise, the bladder and prostate were morphologically normal.

The patient was brought to the operating room for cystoscopy followed by open radical retropubic prostatectomy (RRP) and left ureteroureterostomy.

During cystoscopy, the lower pole ureteral orifice was easily visualized, and a left retrograde pyelogram was performed, demonstrating a normal renal unit. A 5 Fr open-ended catheter was placed. The ectopic upper pole ureteral orifice was not visualized despite injection of intravenous indigo carmine.

An open RRP was performed using a previously described technique.[5] After mobilization of the prostate, the catheter was retracted in a cephalad direction and Denonvilliers fascia overlying the seminal vesicles and vasa was incised and the rectum was bluntly mobilized off these structures. The vasa were ligated and divided and mobilized off the seminal vesicles. A third tubular structure was identified lateral to the left seminal vesicle that represented the left upper pole ectopic ureter. The wall of the ectopic ureter was intimately associated with the bladder wall prior to traversing the prostate. The left upper pole ectopic ureter was transected approximately 5 cm prior to entering the prostate and was intubated with a 5 Fr open-ended catheter passed in a retrograde manner. The dissection of the prostate and seminal vesicles was then completed.

The ectopic ureter was mobilized with meticulous care to preserve its blood supply. The left lower pole ureter, which was previously stented, was identified. A 2-cm longitudinal incision was made in the lower pole ureter. Both stents were removed. The left upper pole ureter was spatulated, and then anastamosed in an end-to-side fashion to the lower pole segment with a running 5.0 polydioxanone (PDS) suture. Prior to completing the anastomosis, a 5 Fr open-ended stent was placed retrograde into the lower pole ureter, across the anastomosis, and into the upper ureter. The anastomosis was observed to be watertight with no extravasation.

A 26 Fr Malecot catheter was positioned into the bladder through a stab incision into the dome of the bladder. The vesicourethral anastomosis was performed in the usual fashion over an 18 Fr Foley catheter.[5] The ureteral stent and suprapubic tube were brought out to the skin through separate incisions in the abdominal wall.

On pathology examination, the orifice of the ectopic ureter was easily cannulated with a metal probe that traversed through the prostate along the intraprostatic portion of the ureter and exited into the prostatic urethra approximately 5 mm distal to the bladder neck and 3 mm proximal to the utricle (Figure 4A). Blue ink was introduced into the lumen and used to assure identification of the channel

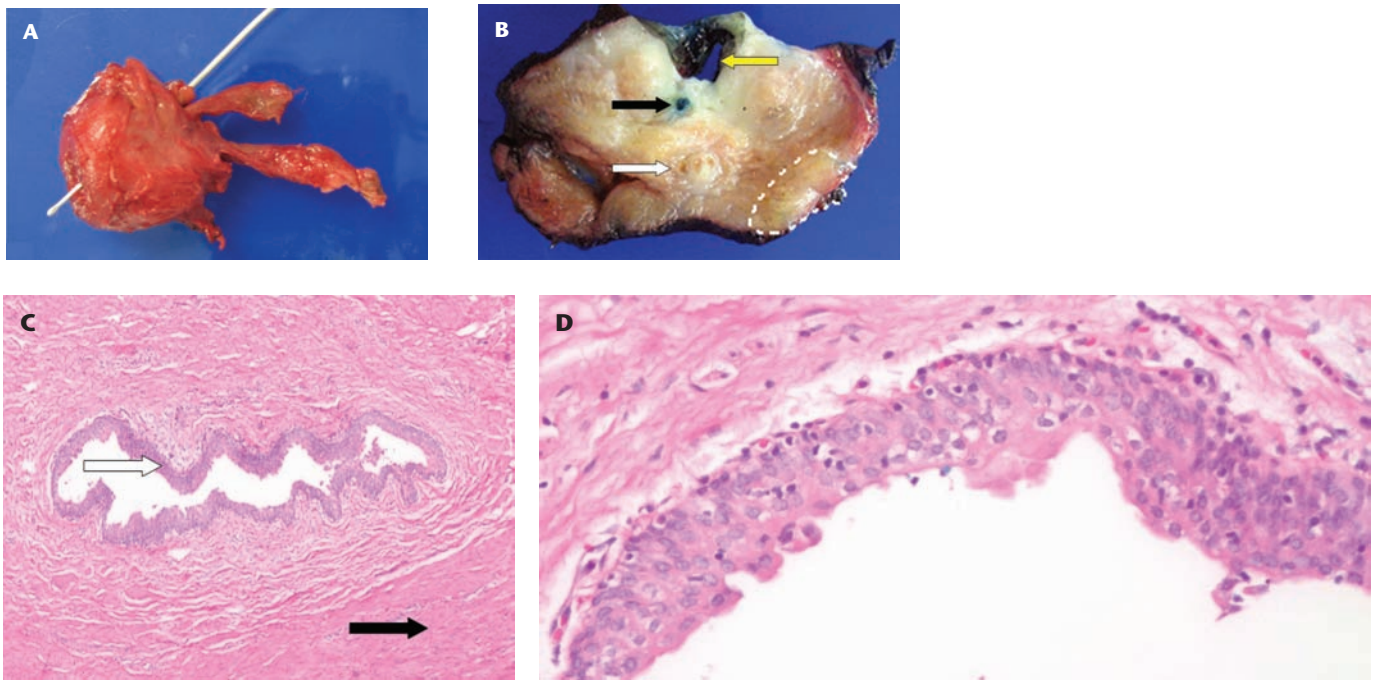


Figure 4. (A) *A probe is inserted into the ectopic ureter posterior to the left seminal vesicle and exits in the prostatic urethra.* (B) *A transverse slice of the prostate at its midportion demonstrates the anteriorly located ureter lumen, well demarcated by the blue ink that had been previously introduced when the ureter was cannulated (black arrow). Note that the ureter is anteriorly located and approaching near to the prostatic urethra (yellow arrow). The posteriorly located ejaculatory duct lumens provide orientation as to midline (white arrow). The peripherally located focus of cancer on the right is outlined in white.* (C) *Urothelial lined lumen (white arrow) of the ureter traverses through the fibromuscular stroma (black arrow) of the prostate without a distinct muscularis layer (hematoxylin and eosin [H&E] stain, 40×). Higher magnification* (D) *of ureter lining showing stratified epithelial layer with umbrella cells characteristic of urothelium (H&E stain, 200×).*

on sectioning the prostate. The prostate was sectioned in the standard fashion into transverse slices perpendicular to its long axis. The intraprostatic ureteral channel could be visualized on individual slices (Figure 4). Histological examination revealed a usual acinar adenocarcinoma, Gleason score 6 (3 + 3), located toward the periphery of the prostate on the right, occupying approximately 15% of the prostate gland with evidence of focal extraprostatic extension (pT3a disease), and negative surgical margins. There was no seminal vesicle invasion.

The ectopic ureter entered the prostate posterior to the left seminal vesicle (Figure 4A) and traversed the prostate separately from the ejaculatory ducts and away from the tumor. Its lumen was distinct from the prostatic and ejaculatory ducts and merged into prostatic stroma without a distinct muscularis layer. The lumen diameter measured approximately 2 mm. Figure 4B shows blue ink within the lumen (black arrow) traversing through the prostate more anterior to the ejaculatory ducts (white arrow) and away from the area of cancer (nodular area at periphery on right indicated by the broken white line). Figure 4C shows the undulating lumen of the ureter set directly in fibromuscular stroma of prostate without a distinct muscularis layer. Figure 4D is a higher magnification image showing stratified epithelium with an umbrella layer characteristic of urothelium (200×).

The postoperative course was uneventful. On postoperative day 8, a stentogram showed no extravasation at the left ureteroureteral anastomosis (Figure 5A). Cystography under fluoroscopic control also showed no extravasation from the vesicourethral anastomosis (Figure 5B). The ureteral stent and Foley catheter were removed. Three days later, the suprapubic catheter was removed.

Three months following open RRP, total urinary continence was achieved. A 3-month postoperative ultrasound showed no evidence of left hydronephrosis and there is total preservation of renal parenchyma (Figure 6).

Discussion

The ectopic ureter is characterized by a ureter inserting outside of the normal anatomical position within the trigone. Ectopic ureters are generally grouped into 2 categories. *Lateral ectopic ureters* insert more cranially and laterally than the normal position, still within the bladder. These ureters

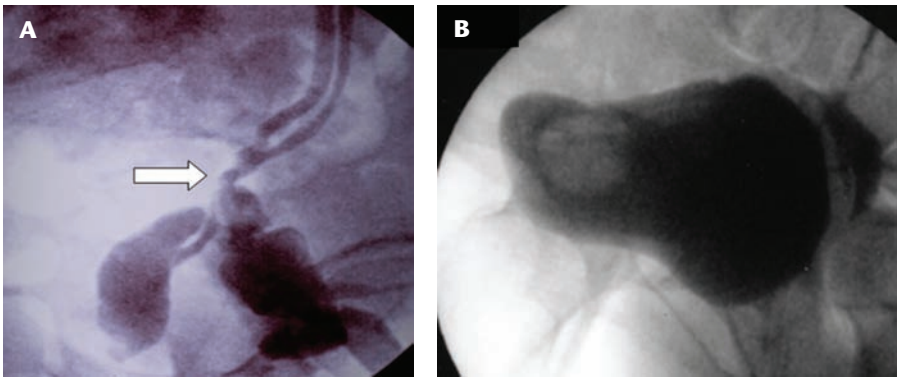


Figure 5. *Contrast was injected retrograde into the left ureteral stent and into the Foley catheter. There was no extravasation at the site of the ureteroureteral anastomosis (white arrow in* A*) and none at the site of the bladder urethral anastomosis* (B).

Figure 6. *Renal ultrasound of the left kidney following radical prostatectomy and left ureteroureterostomy demonstrating no hydronephrosis and normal renal parenchyma.*

can be associated with single systems or with the lower pole moiety of a duplication and are prone to vesicoureteral reflux. *Caudal ectopic ureters* insert more medially and distally than the normal position and are more often outside of the bladder or extravesical. In practice, caudal ectopic ureters are generally implied when discussing ectopic ureters.

Ectopic ureter is a rare congenital anomaly. In a study of 19,046 autopsies on children, the incidence was 1 in 1900.[1] Ectopic ureters occur more commonly in females and typically are associated with a duplicated collecting system.[2] Ectopic ureters occurring in males are more often associated with a single collecting system.[2,6,7] In the case of an ectopic ureter and a duplicated collecting system, the upper pole ureter is more commonly ectopic and the lower pole ureter typically inserts into the trigone, or laterally and cranially to this structure. This anatomic location of the duplicated ureters is known as the Weigert-Meyer rule.

Ectopic ureters can insert into a number of structures outside of the bladder. In men, nearly 50% insert into the prostatic urethra and 33% into a seminal vesicle. The prostatic utricle and the vas deferens are the least common sites of ectopia.[8] In females, roughly 33% of the ectopic ureters insert into the urethra, another 33% insert into the vestibule, and 25% insert into the vagina. Insertion of ectopic ureters into the uterus or cervix is quite rare.[8]

The presentation of an ectopic ureter often depends upon the location of insertion. As prenatal ultrasound is performed on the vast majority of pregnant women, an increasing proportion of renal anomalies, including ectopic ureters, are discovered in utero and manifest with hydronephrosis or hydroureteronephrosis. Discovery of ectopic ureters on prenatal ultrasound provides the opportunity for early intervention with preservation of renal parenchyma if possible. Early repair of selected cases decreases the rate of delayed partial or total nephrectomies.[9]

When the insertion site is distal to the urethral sphincter, the classic presentation of an ectopic ureter in females is continuous dribbling of urine with an otherwise normal voiding pattern.[10] In cases where the insertion is proximal to the sphincter, ectopic ureter may present with lower urinary symptoms, including urge incontinence, urinary tract infections, enuresis, failure to thrive, reflux, obstruction with hydronephrosis, and as an abdominal mass.[2,11]

Ectopic ureters in men almost never insert distal to the external sphincter and, as such, this anomaly almost never presents with incontinence, although a single case is reported in the literature.[12] Men who have an ectopic ureter inserting into the prostatic urethra typically present with urinary tract infections or lower urinary tract symptoms of urgency and frequency.[2,6,11] Ectopic ureters inserting into a seminal vesicle, vas deferens, or epididymis may present with epididymitis, chronic prostatitis, abdominal pain, pelvic pain, discomfort during ejaculation, constipation, or a large abdominal mass secondary to obstruction and hydronephrosis.[2,6,11,13-15] Infertility may also be a presenting sign in men with ectopic ureters.[16,17]

It is quite rare for embryologic abnormalities of the urinary tract to present in adulthood, especially as an incidental finding in a man with prostate cancer being evaluated for radical prostatectomy.

Prior to prenatal ultrasonography, ectopic ureters were usually discovered in early childhood. It is quite rare for embryologic abnormalities of the

urinary tract to present in adulthood, especially as an incidental finding in a man with prostate cancer being evaluated for radical prostatectomy.[18] Our case describes an incidental ectopic ureter associated with a normal functioning upper pole moiety discovered as an incidental finding in an adult man with clinically localized prostate cancer. To our knowledge, there are only 2 other cases in the literature reporting similar findings. The first case described a 69-year-old man diagnosed with prostate cancer who had incidental bilateral duplicated collecting systems, with a left upper pole hydroureter inserting into the prostatic urethra. The distal portion of the ectopic ureter was stenotic and contained several stones. A radical prostatectomy, ureterolithotomy, and reimplantation of the ectopic ureter into the bladder was performed.[3] A second case described a 71-year-old man with bothersome urinary frequency and clinically localized prostate cancer who had an incidental complete right duplication of the collecting system with the upper pole ureter inserting into the prostatic urethra. A radical prostatectomy and ureteroureteral anastomosis of the upper pole ureter to the lower pole ureter was performed.[4]

The current case describes a man with clinically localized prostate cancer who was incidentally found to have a complete duplication of the left collecting system with an upper pole ectopic ureter inserting into the prostatic urethra. A preoperative MRI was performed that provided the opportunity to detect the duplicated system and the ectopic ureter inserting into the prostatic urethra prior to undergoing radical prostatectomy. The preoperative diagnosis enabled appropriate assessment and planning prior to surgery. The ectopic ureter was repaired with an ureteroureterostomy instead of a ureteral reimplantation because the former technique can be performed quickly, and there is less chance of devascularizing the distal ureters.[19] It obviates the need for a double-barrel ureteral reimplant.

Imaging of the prostate with MRI or CT is not routinely performed in men with low-risk disease prior to radical prostatectomy.[20] We have recently begun obtaining contrast-enhanced MRI scans prior to radical prostatectomy in order to gain insight into the reliability of this test in identifying the site and extent of disease. We also image the inguinal area under Valsalva in order to detect subclinical hernias. In our case, MRI did not identify the extracapsular extension. However, MRI did detect the ectopic ureter inserting into the prostatic urethra, allowing for the appropriate preoperative planning. In spite of this, owing to the rarity of embryogenic abnormalities of the upper urinary tract presenting in men, it is not justified to perform this type of imaging procedure as a means to screen for these anomalies. ■

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Main Points

- Ectopic ureters are less common in males than in females, but when present can present in adolescence and adulthood.
- In males, ectopic ureters are more commonly found in a kidney with a single collecting system. In females, they are more commonly associated with a duplex system and often present early with urinary incontinence.
- The most common location for an ectopic ureter in males is the prostatic urethra.
- Ectopic ureters are rarely found in the setting of prostate cancer; the current case is only the third reported in the literature.
- Preoperative imaging can help detect asymptomatic congenital abnormalities of the urinary tract, enabling appropriate surgical planning. However, given the rarity of such anomalies and the expense of the imaging, imaging solely for the purpose of screening for congenital abnormalities is not justifiable in this setting.

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